TABLE OF CONTENTS

Appendix F Shuttle car trailing cables 1

F.1 Load profile 1

F.1.1 Section 21 2

F.1.1.1 Morning shifts 2

F.1.1.2 Afternoon shifts 5

F.1.2 Section 61 8

F.1.2.1 Morning shifts 8

F.1.2.2 Afternoon shifts 11

F.2 Histogram 15

F.2.1 Section 21 16

F.2.1.1 Morning shifts 16

F.2.1.2 Afternoon shifts 17

F.2.2 Section 61 18

F.2.2.1 Morning shifts 18

F.2.2.2 Afternoon shifts 19

APPENDIX F

SHUTTLE CAR TRAILING CABLES

The total consumption of a Shuttle car was measured at the Gate end boxes of each section, which supplies the Shuttle car with power. The present sustained capacity of a Shuttle car's trailing cable could thus be determined. Measurements were made on the supply to a Shuttle car for a number of shifts as can be seen in Table F-1.

Table F-1: Measuring period for a CM at each section.

		17-May-2005	18-May-2005	19-May-2005	23-May-2005	24-May-2005	25-May-2005
Section 21	Morning shift	X	X	X	-	-	-
	tonnes/CM/shift	858	1320	1716	1320	1650	1749
	Afternoon shift	X	X	X	-	-	-
	tonnes/CM/shift	2145	2112	2013	2310	1980	1980
Section 61	Morning shift	-	-	-	X	X	X
	tonnes/CM/shift	1740	2175	2233	1740	1450	2320
	Afternoon shift	-	-	-	X	X	X
	tonnes/CM/shift	1682	2552	2320	2030	2320	1160

X - measurements made for shift, at specific section.

Shuttle cars are supplied with power from Gate end boxes with a 16 mm^2 trailing cable that is generally 200 meters long. The cable is rolled on a drum and is rolled or unrolled as the Shuttle car trams from one point to another. The drum can hold 12 turns on each layer and a maximum of six layers.

The cable is rated for a current of 105 A at an ambient temperature of 30 ℃. The derating factor for an ambient temperature of 25 ℃ is 1.1, which gives a current rating of 115 A for the cable. The derating factor for one layer is 0.84, which gives current rating of 97 A. For three layers it's a derating factor of 0.45, which gives a current rating of 52 A and for 5 layers the derating factor is 0.05 which gives a current of 6 A.

F.1 LOAD PROFILE

The next section focuses on the load profiles of the Shuttle cars. Each graph shows the line voltage and the voltage limits, the load current and rated current capacity of the cable. The morning shifts and afternoon shifts are separated as well as the measurements made at the different sections.

F.1.1 SECTION 21

F.1.1.1 Morning shifts

Table F-2: Reasons for breakdowns and absent data.

Date	Time start	Time stop	Reason for no data
17-May-2005	SOS	EOS	No current data - supply switch changed because of repeated tripping.
18-May-2005	SOS 11:46	08:45 14:38	CM cable damaged and E-stop faulty. SC trailing cable damaged.
19-May-2005	SOS 09:44 12:10	08:27 12:10 12:20	CM cable damaged. SC trailing cable damaged - no spare. SC's changes cables.

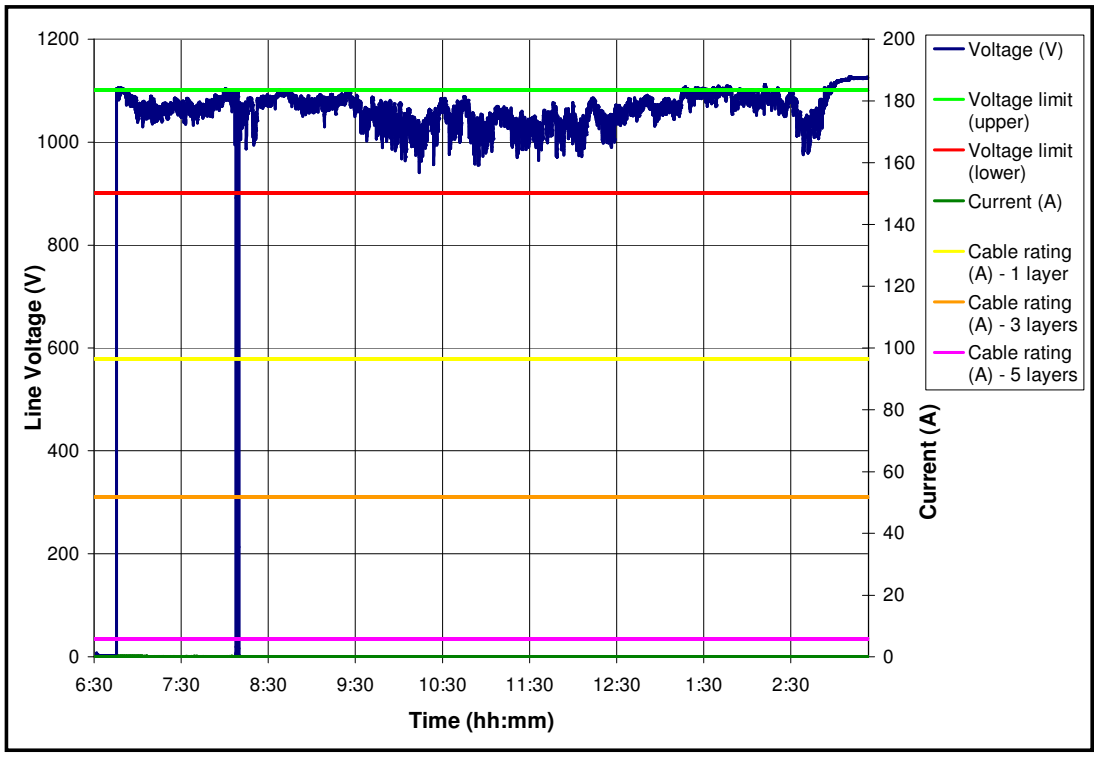

Figure F.1-1: Load current and voltage for a SC – 17 May 2005.

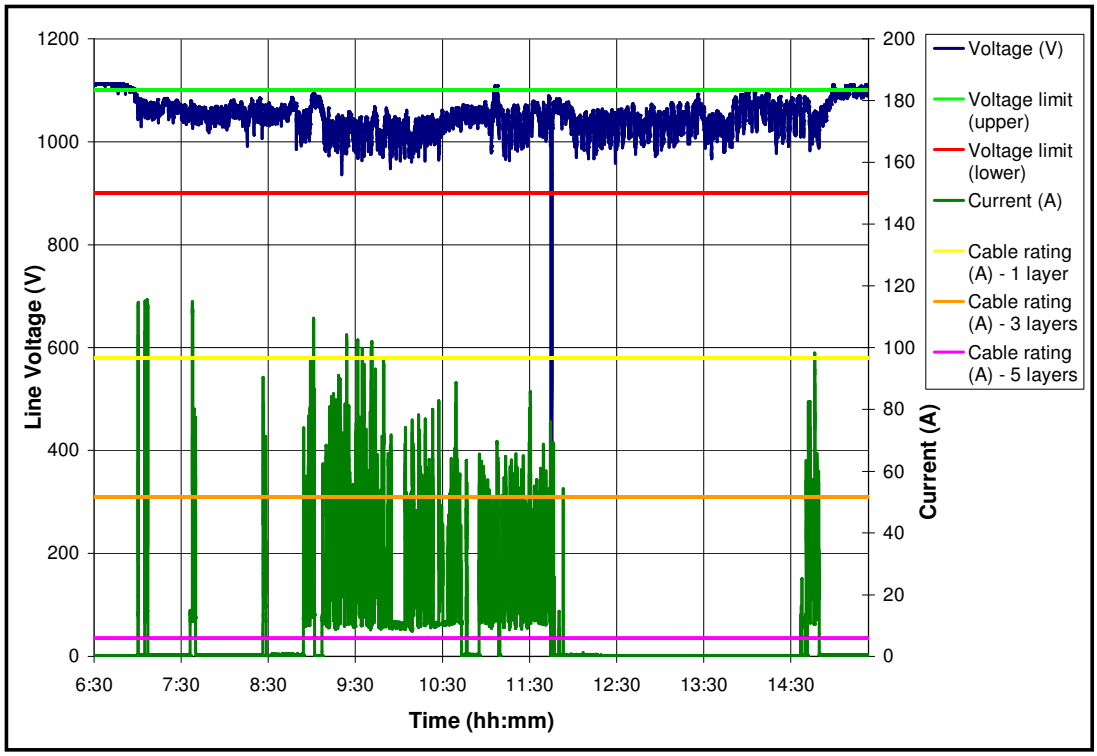

Figure F.1-2: Load current and voltage for a SC – 18 May 2005.

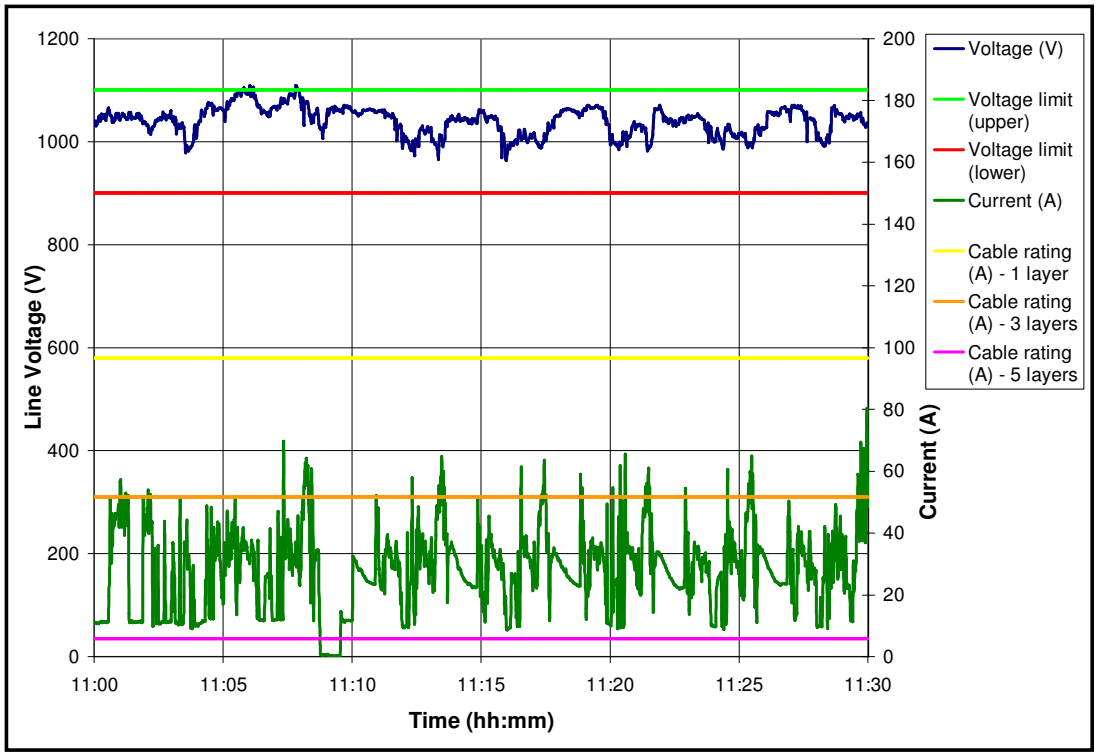

Figure F.1-3: Load current and voltage for a SC – 18 May 2005 (30 minute period).

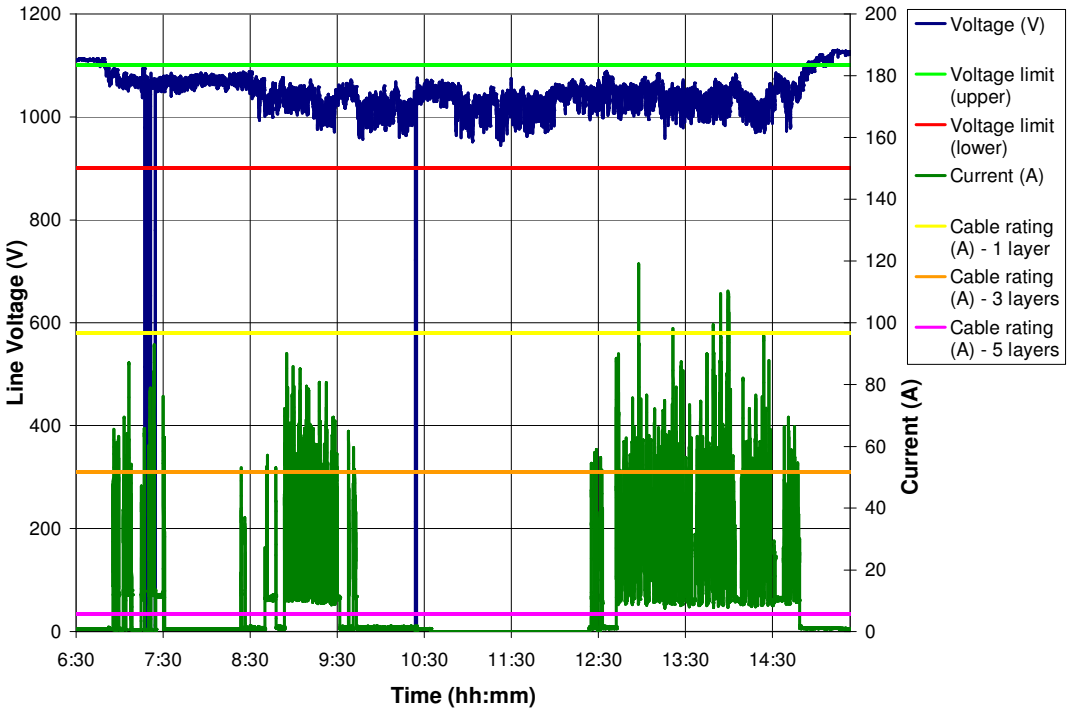

Figure F.1-4: Load current and voltage for a SC – 19 May 2005.

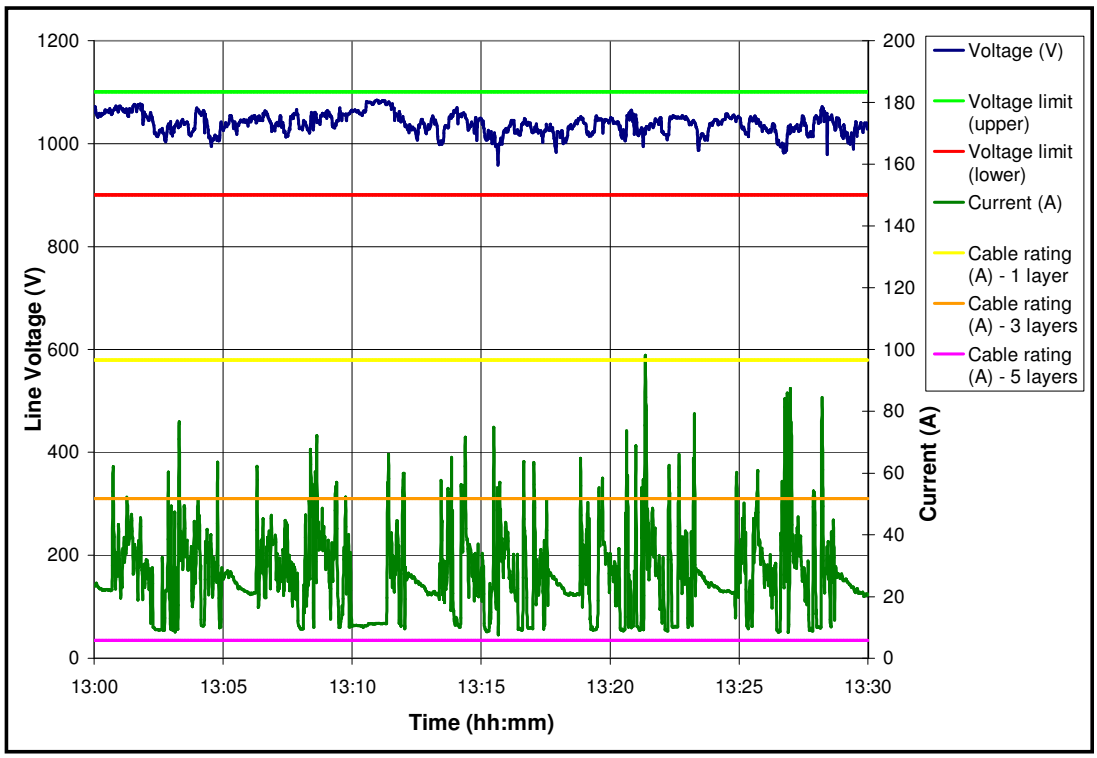

Figure F.1-5: Load current and voltage for a SC – 19 May 2005 (30 minute period).

F.1.1.2 Afternoon shifts

Table F-3: Reasons for breakdowns and absent data.

Date	Time start	Time stop	Reason for no data
17-May-2005	SOS	EOS	No current data - supply switch changed because of repeated tripping.
	23:14	EOS	No voltage data - recorder stopped recording.
18-May-2005	23:00	EOS	SC trailing cable damaged - no spare.
	22:34	EOS	No voltage data - recorder stopped recording.
	22:53	EOS	No current data - recorder stopped recording.
19-May-2005	22:20	EOS	SC steering jack broken.
	22:20	EOS	No current data - recorder stopped recording.
	22:44	EOS	No voltage data - recorder stopped recording.

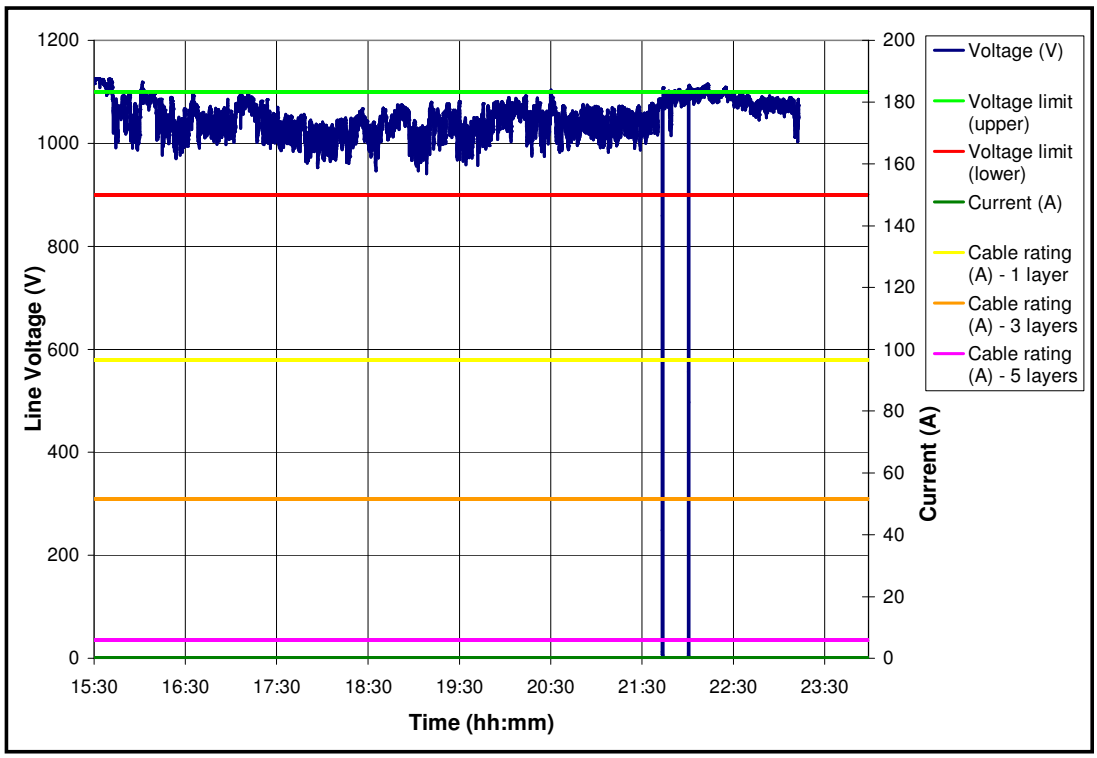

Figure F.1-6: Load current and voltage for a SC – 17 May 2005.

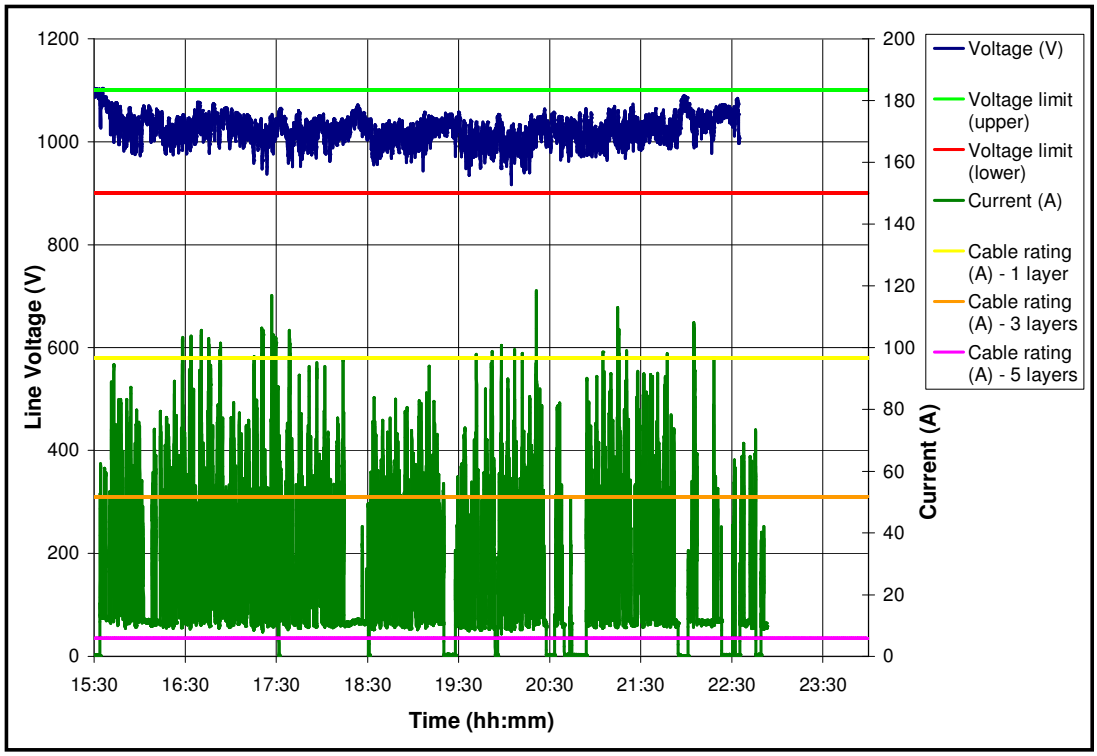

Figure F.1-7: Load current and voltage for a SC – 18 May 2005.

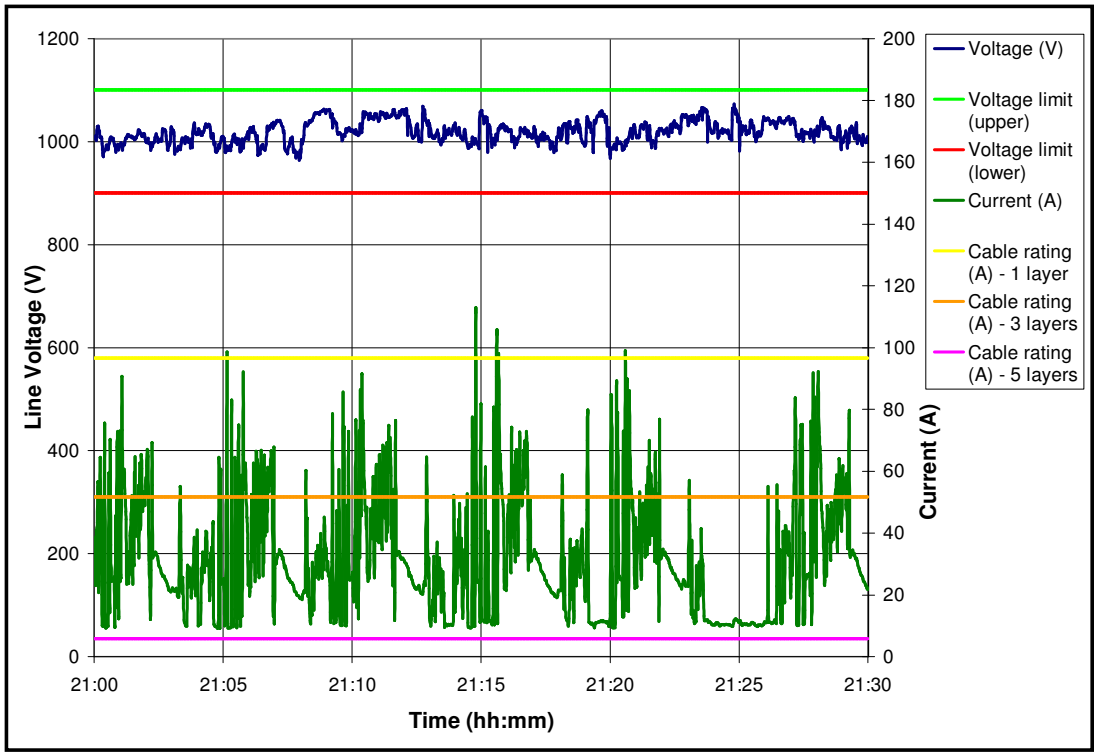

Figure F.1-8: Load current and voltage for a SC – 18 May 2005 (30 minute period).

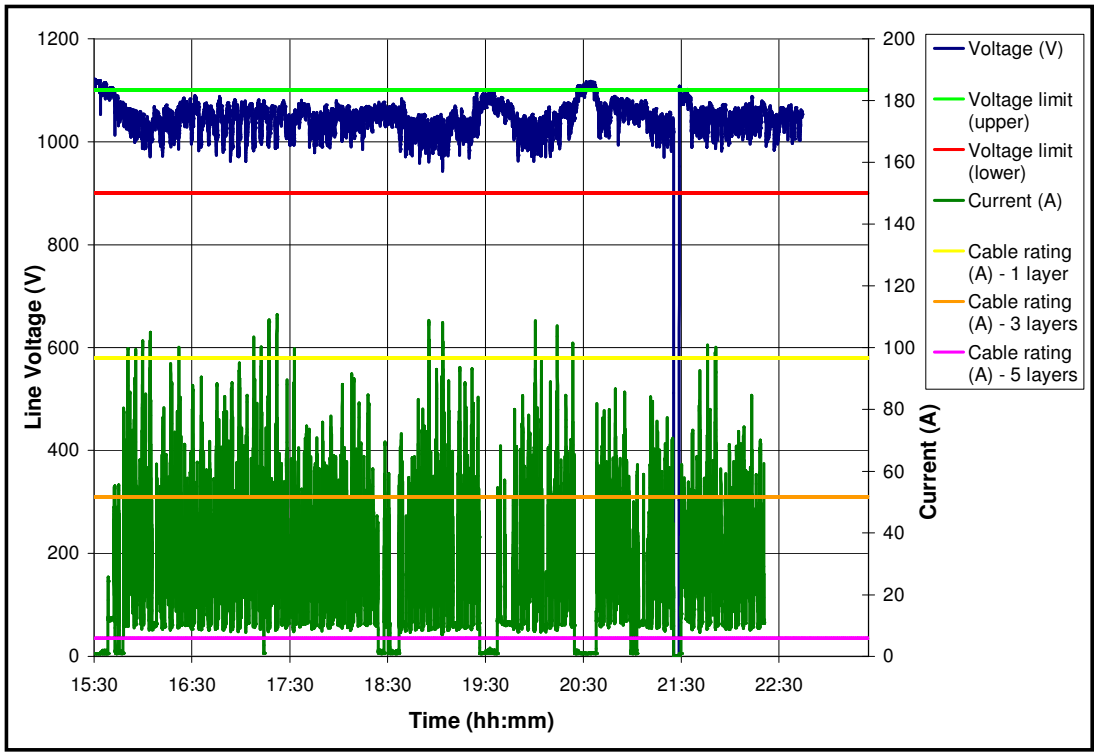

Figure F.1-9: Load current and voltage for a SC – 19 May 2005.

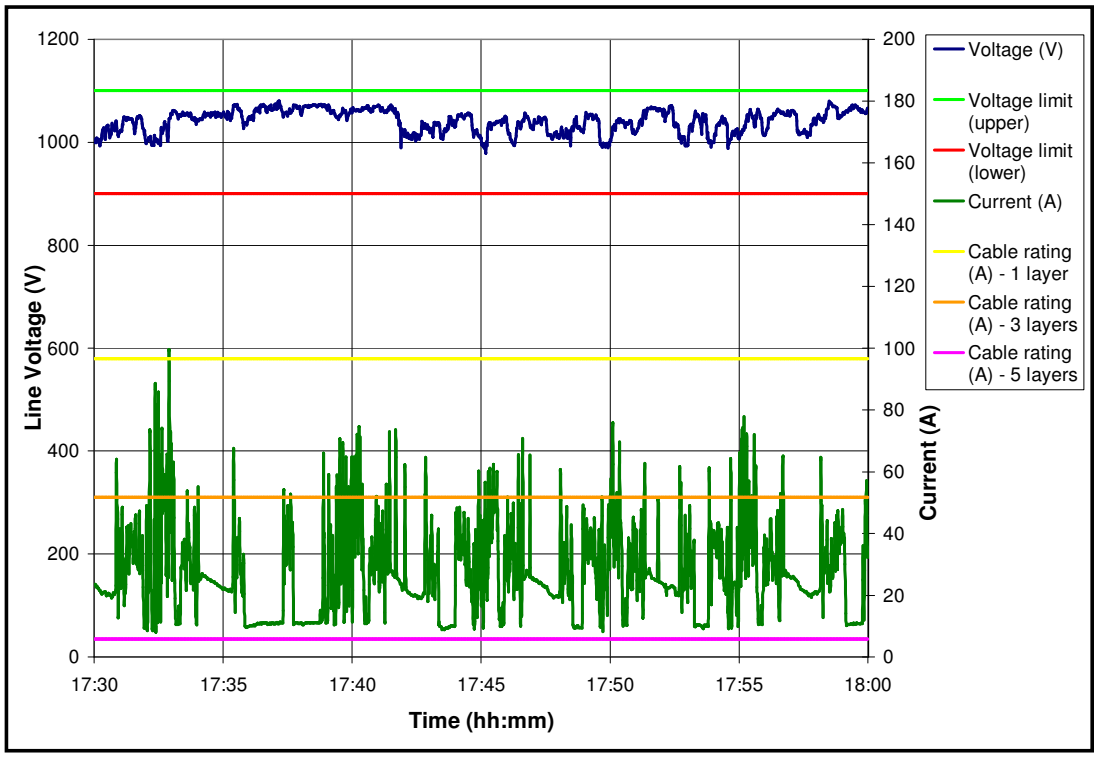

Figure F.1-10: Load current and voltage for a SC – 19 May 2005 (30 minute period).

F.1.2 SECTION 61

F.1.2.1 Morning shifts

Table F-4: Reasons for breakdowns and absent data.

Date	Time start	Time stop	Reason for no data
23-May-2005	09:10	EOS	SC trailing cable damaged - no spare.
24-May-2005	07:10	09:10	GEB - Earth fault.
	09:10	10:50	No service water.
25-May-2005	14:45	EOS	Conveyor belt torn - 15 m.

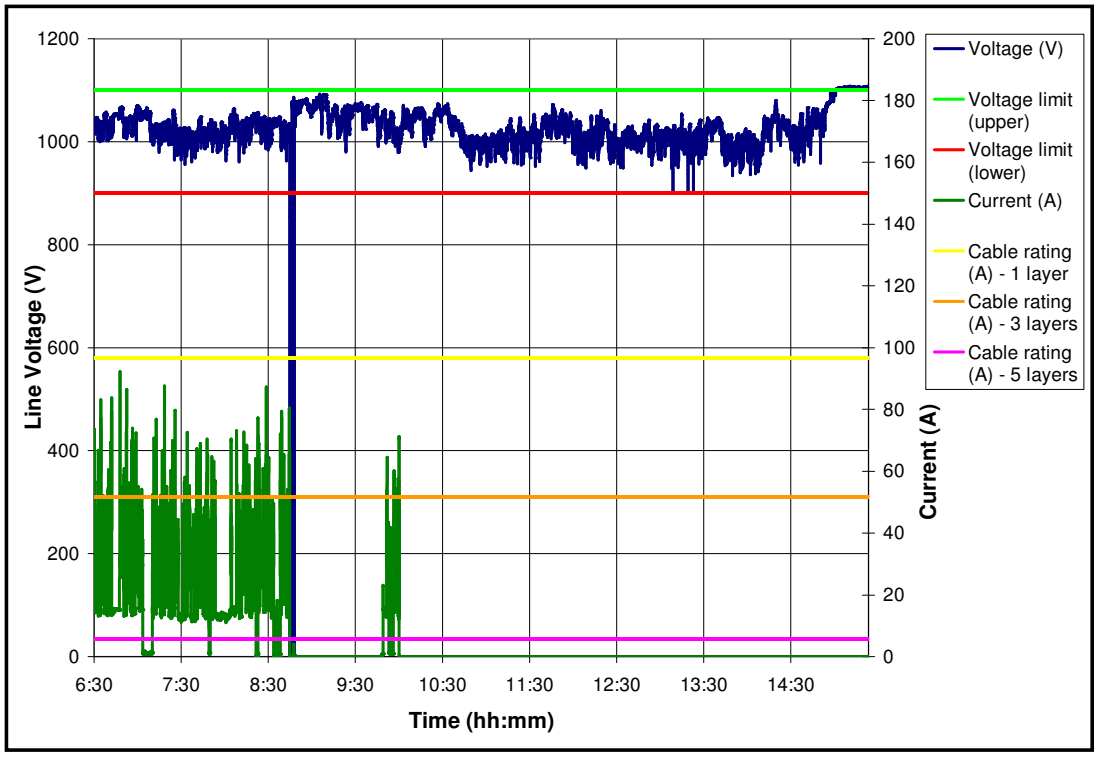

Figure F.1-11: Load current and voltage for a SC – 23 May 2005.

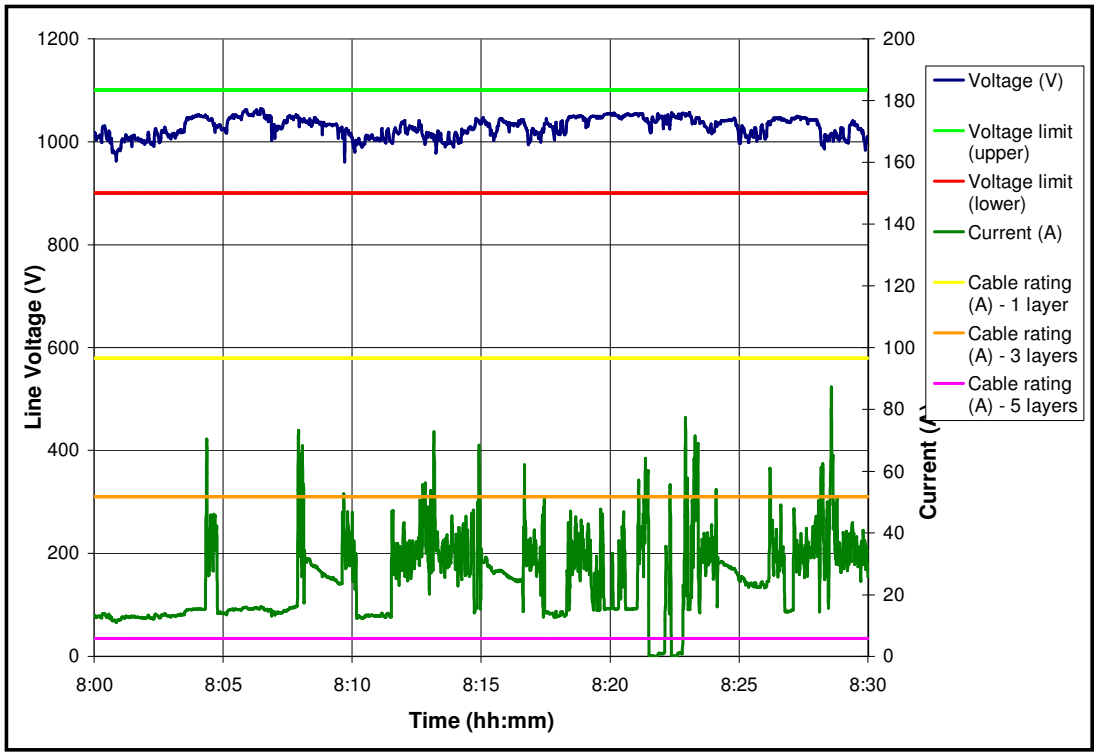

Figure F.1-12: Load current and voltage for a SC – 23 May 2005 (30 minute period).

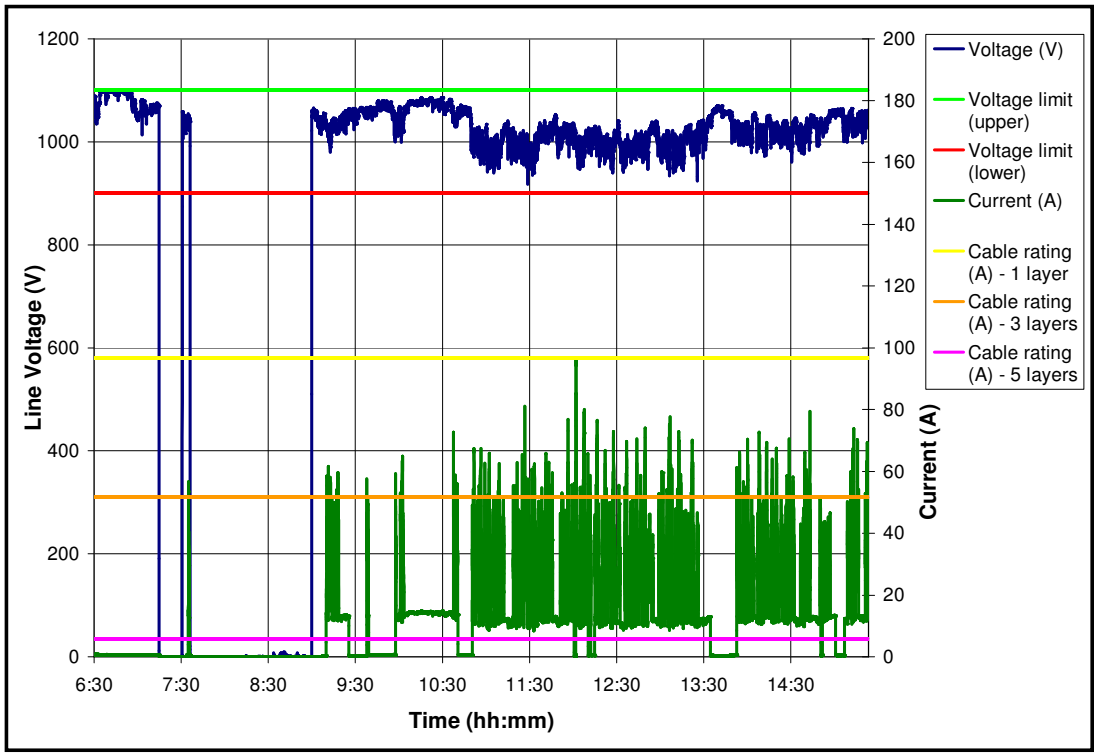

Figure F.1-13: Load current and voltage for a SC – 24 May 2005.

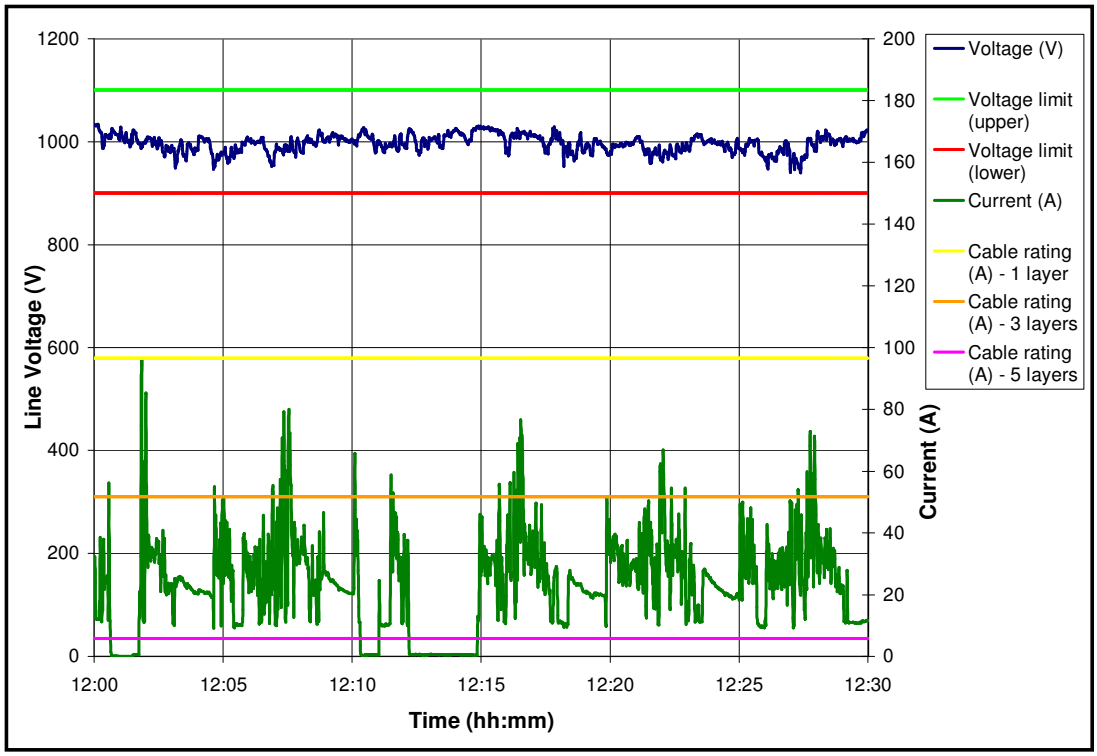

Figure F.1-14: Load current and voltage for a SC – 24 May 2005 (30 minute period).

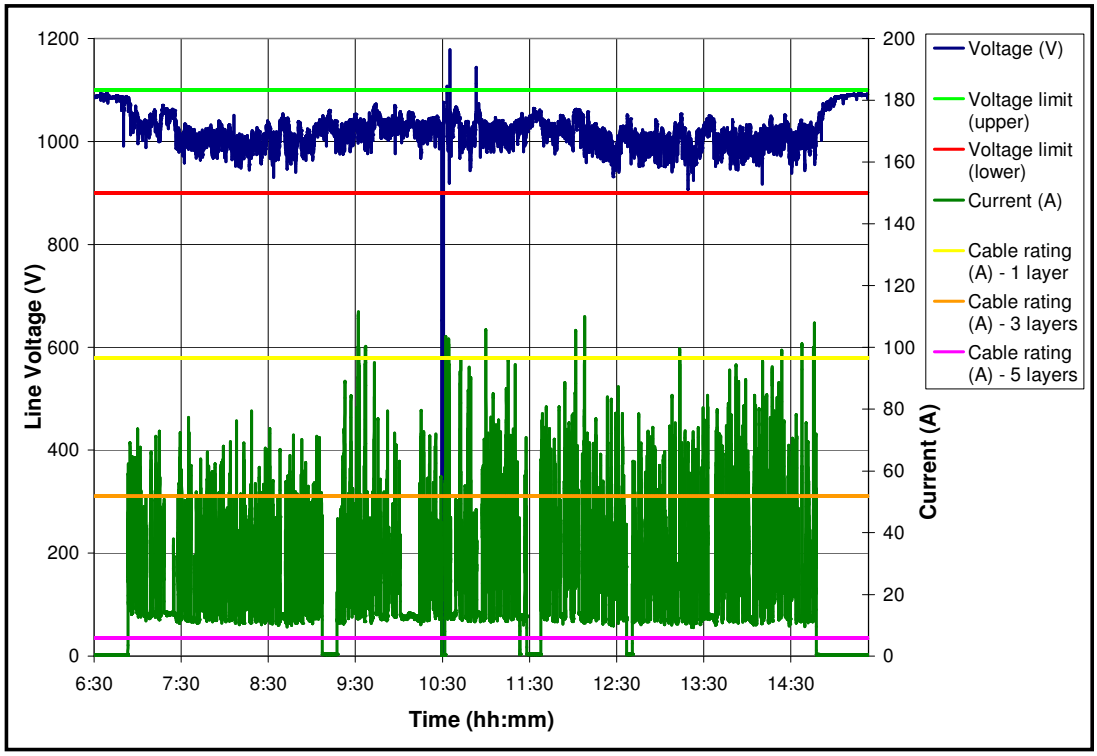

Figure F.1-15: Load current and voltage for a SC – 25 May 2005.

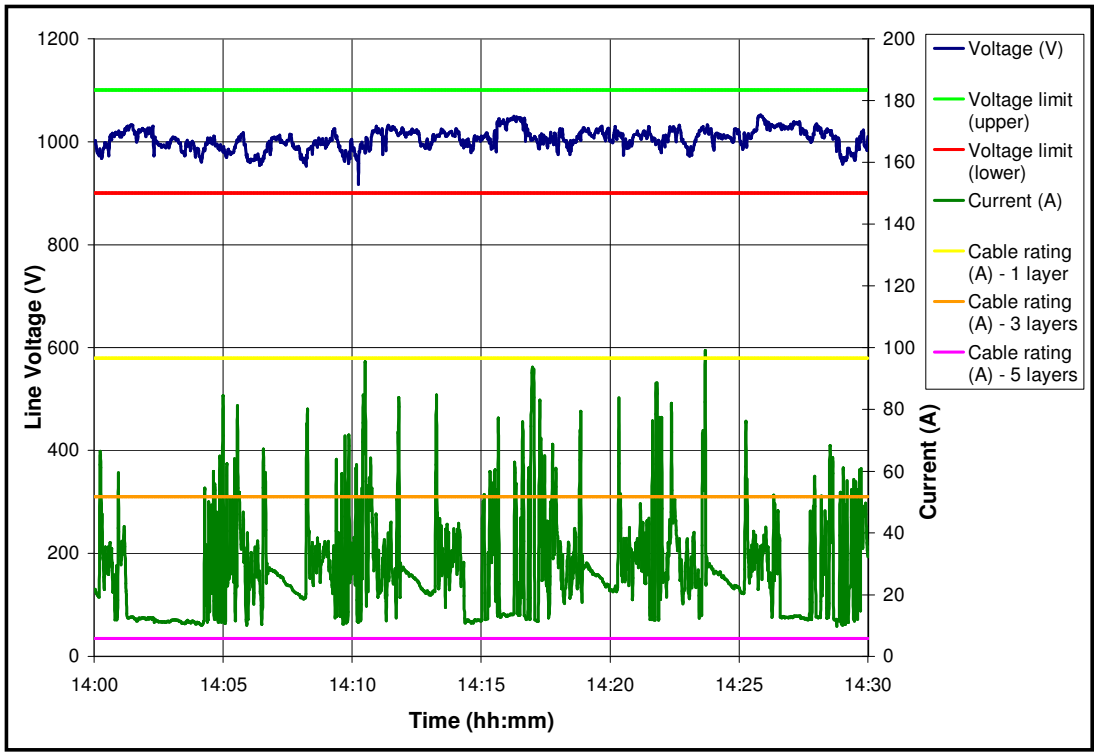

Figure F.1-16: Load current and voltage for a SC – 25 May 2005 (30 minute period).

F.1.2.2 Afternoon shifts

Table F-5: Reasons for breakdowns and absent data.

Date	Time start	Time stop	Reason for no data
23-May-2005	SOS	19:18	SC trailing cable damaged - no spare.
	19:18	EOS	Supply switch changed - switch measured, not being used.
	23:04	EOS	No voltage data - recorder stopped recording.
24-May-2005	22:05	EOS	No current data - recorder stopped recording.
	23:30	EOS	No voltage data - recorder stopped recording.
25-May-2005	19:20	20:45	Conveyor belt torn - 15 m.
	21:10	EOS	Conveyor belt torn - 50 m.
	21:08	EOS	No current data - recorder stopped recording.
	22:59	EOS	No voltage data - recorder stopped recording.

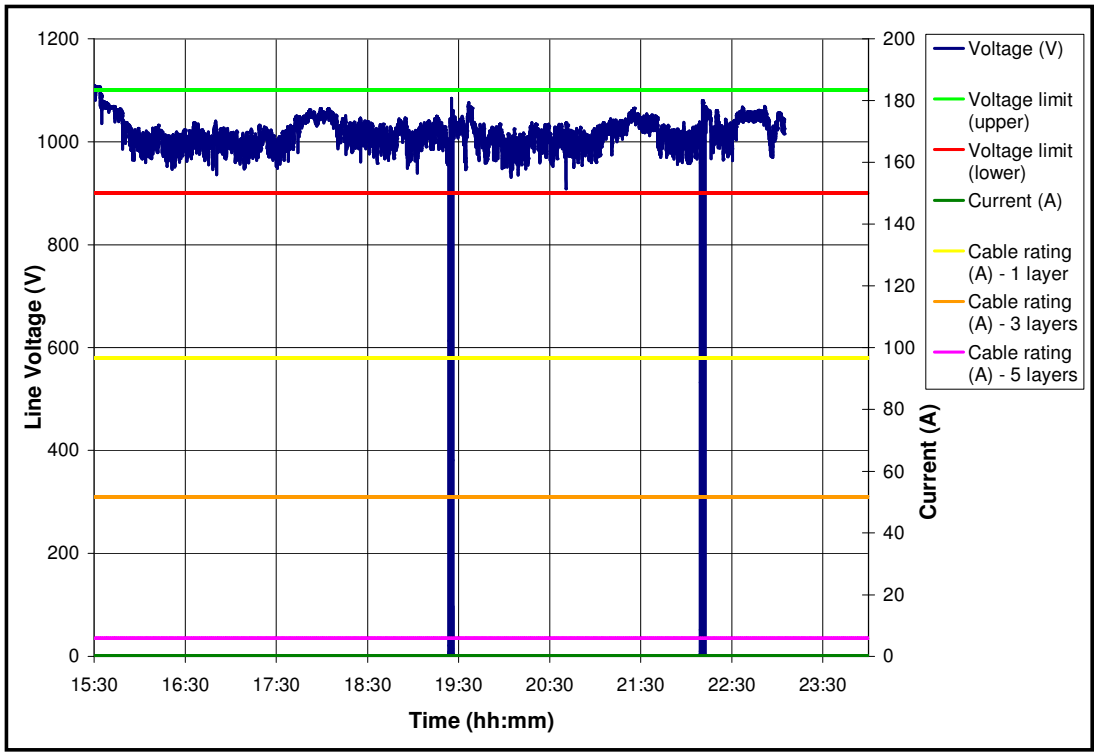

Figure F.1-17: Load current and voltage for a SC – 23 May 2005.

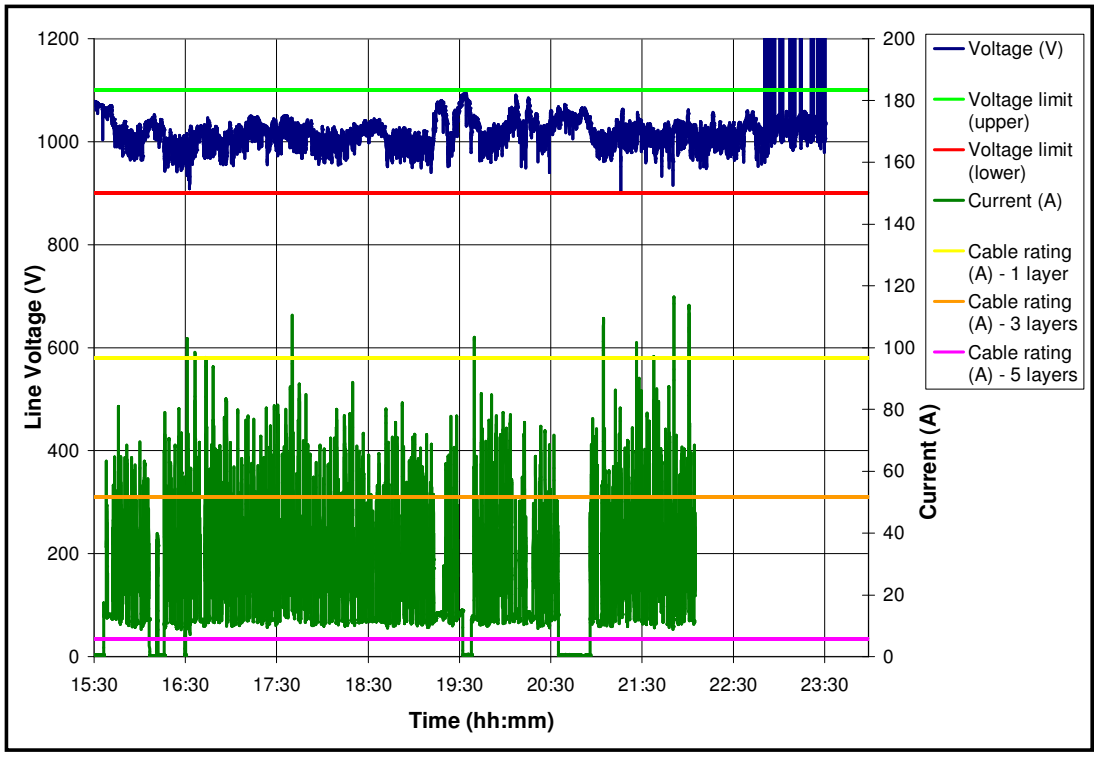

Figure F.1-18: Load current and voltage for a SC – 24 May 2005

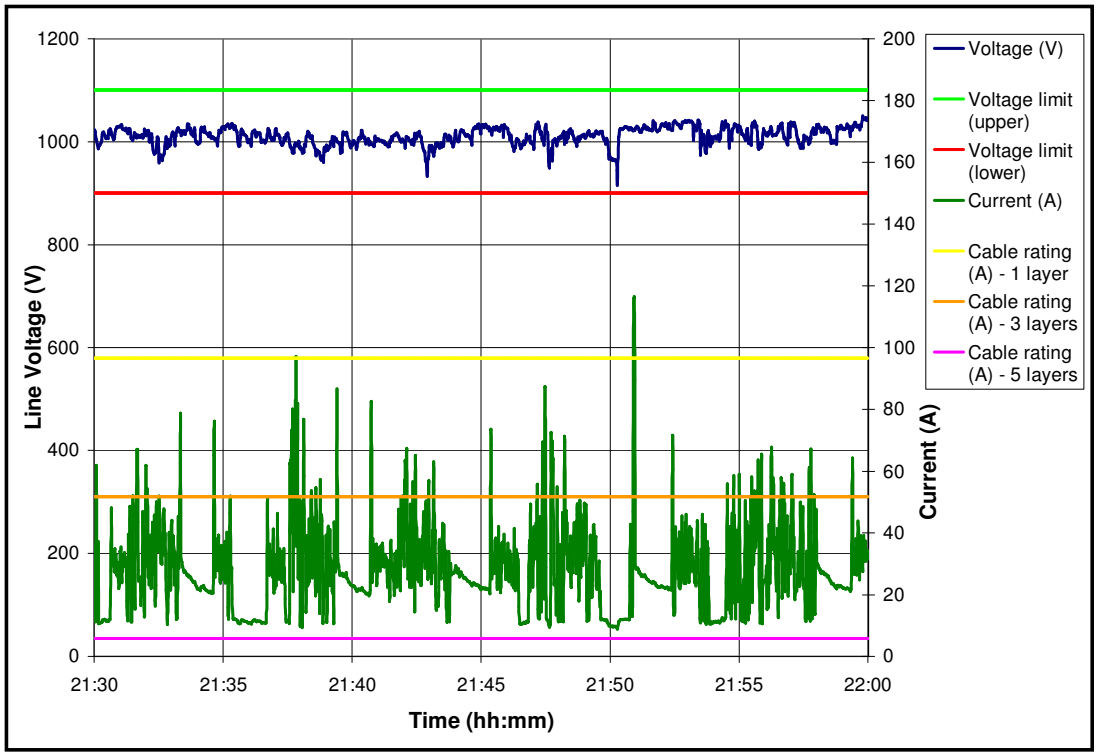

Figure F.1-19: Load current and voltage for a SC – 24 May 2005 (30 minute period).

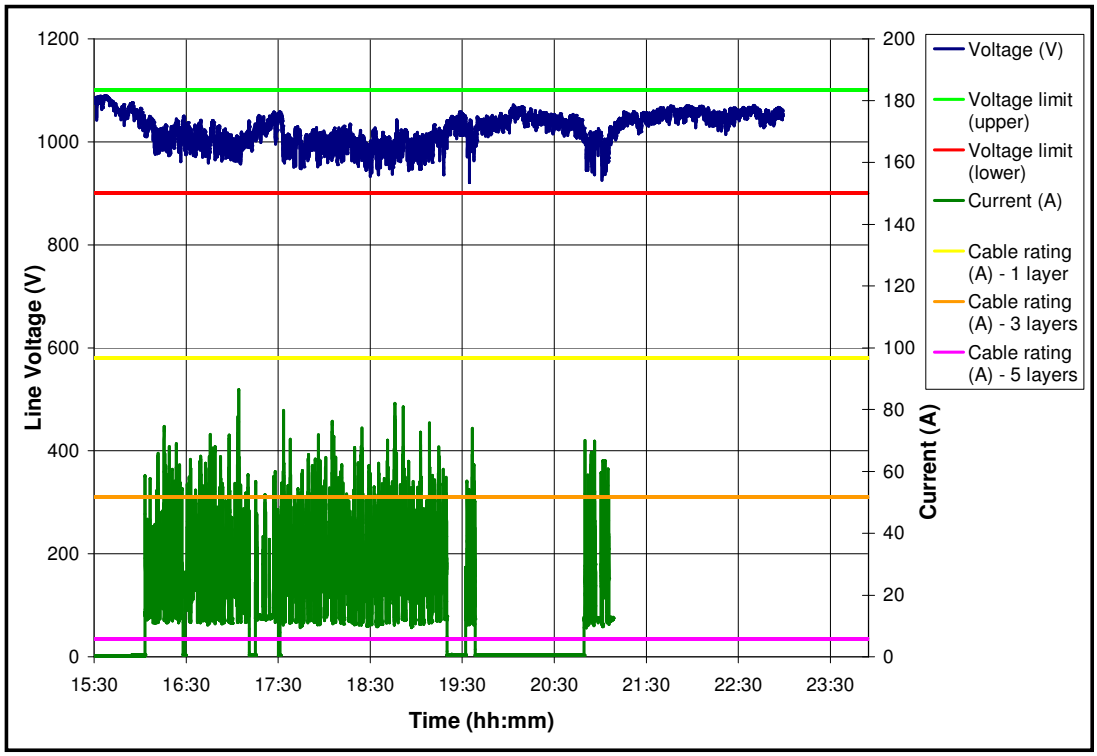

Figure F.1-20: Load current and voltage for a SC – 25 May 2005.

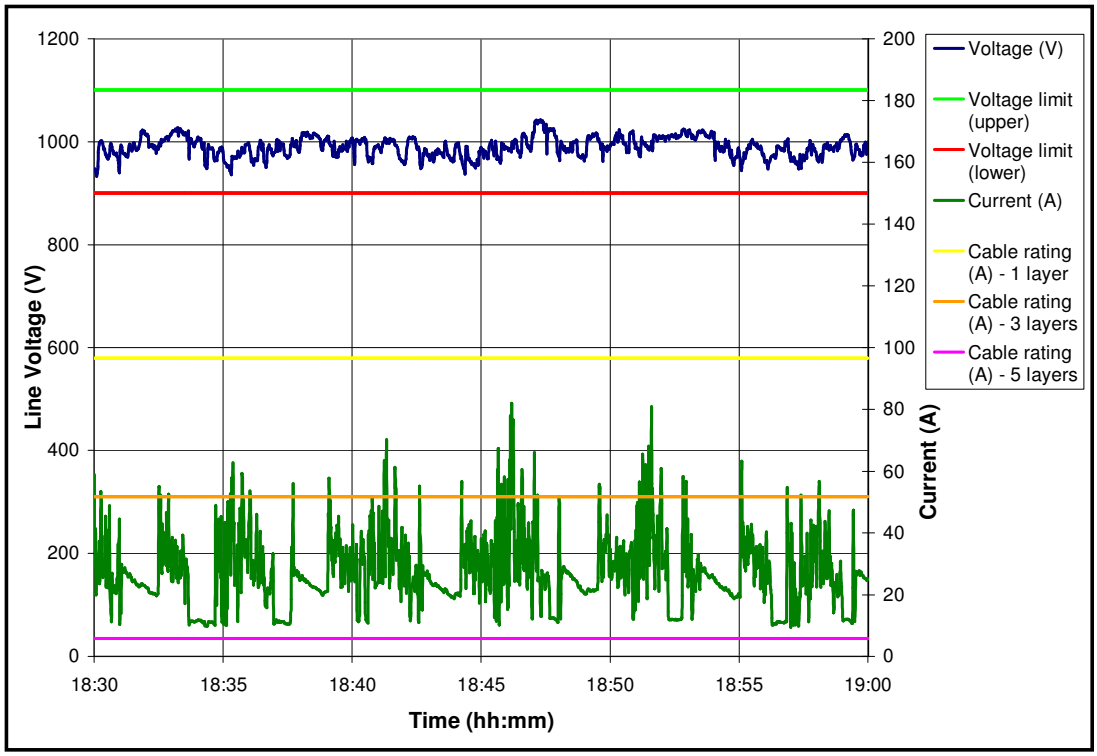

Figure F.1-21: Load current and voltage for a SC – 25 May 2005 (30 minute period).

F.2 HISTOGRAM

The next section focuses on the frequency with which a Shuttle car consumed a certain load current. The graphs show the number of times a certain current has been consumed. The tables give data about the tonnes produced during the shift and the percentage time of the shift that the motors were producing. The time that the cables have been over loaded or loaded within rated capacity of the cables is given as a percentage of the actual producing time. The morning shifts and afternoon shifts are separated as well as the measurements made at the different sections.

F.2.1 SECTION 21

F.2.1.1 Morning shifts

Table F-6: Data for the total consumption of a SC in section 21.

	17-May-05	18-May-05	19-May-05
Tonnes/CM/Shift	858	1320	1716
% Time of shift producing	-	32.24%	36.69%
% of Production time over cable rating - 1 layer	-	0.34%	0.10%
% of Production time over cable rating - 3 layers	-	10.63%	6.15%
% of Production time over cable rating - 5 layers	-	100.00%	100.00%

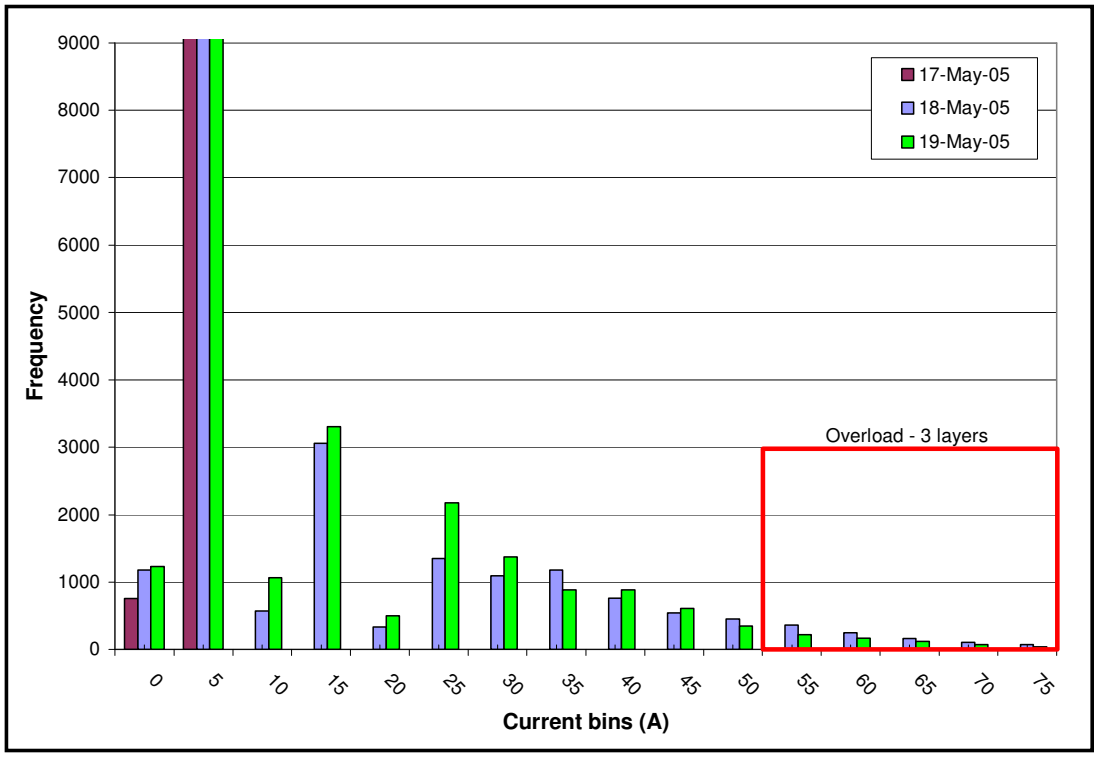

Figure F.2-1: Histogram for current consumed by a SC.

F.2.1.2 Afternoon shifts

Table F-7: Data for the total consumption of a SC in section 21.

	17-May-05	18-May-05	19-May-05
Tonnes/CM/Shift	2145	2112	2013
% Time of shift producing	-	88.18%	86.97%
% of Production time over cable rating - 1 layer	-	0.35%	0.17%
% of Production time over cable rating - 3 layers	-	12.94%	7.88%
% of Production time over cable rating - 5 layers	-	100.00%	100.00%

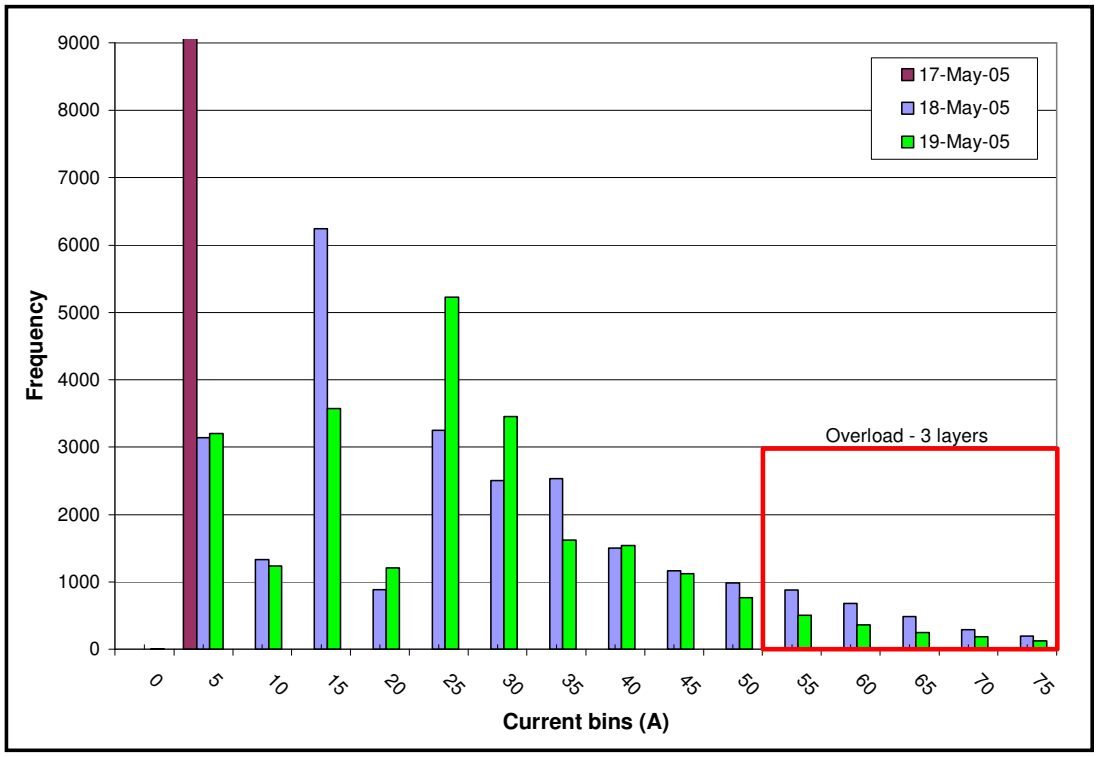

Figure F.2-2: Histogram for current consumed by a SC.

F.2.2 SECTION 61

F.2.2.1 Morning shifts

Table F-8: Data for the total consumption of a SC in section 61.

	23-May-05	24-May-05	25-May-05
Tonnes/CM/Shift	1740	1450	2320
% Time of shift producing	24.14%	56.66%	82.98%
% of Production time over cable rating - 1 layer	0.00%	0.00%	0.06%
% of Production time over cable rating - 3 layers	3.32%	2.22%	5.62%
% of Production time over cable rating - 5 layers	100.00%	100.00%	100.00%

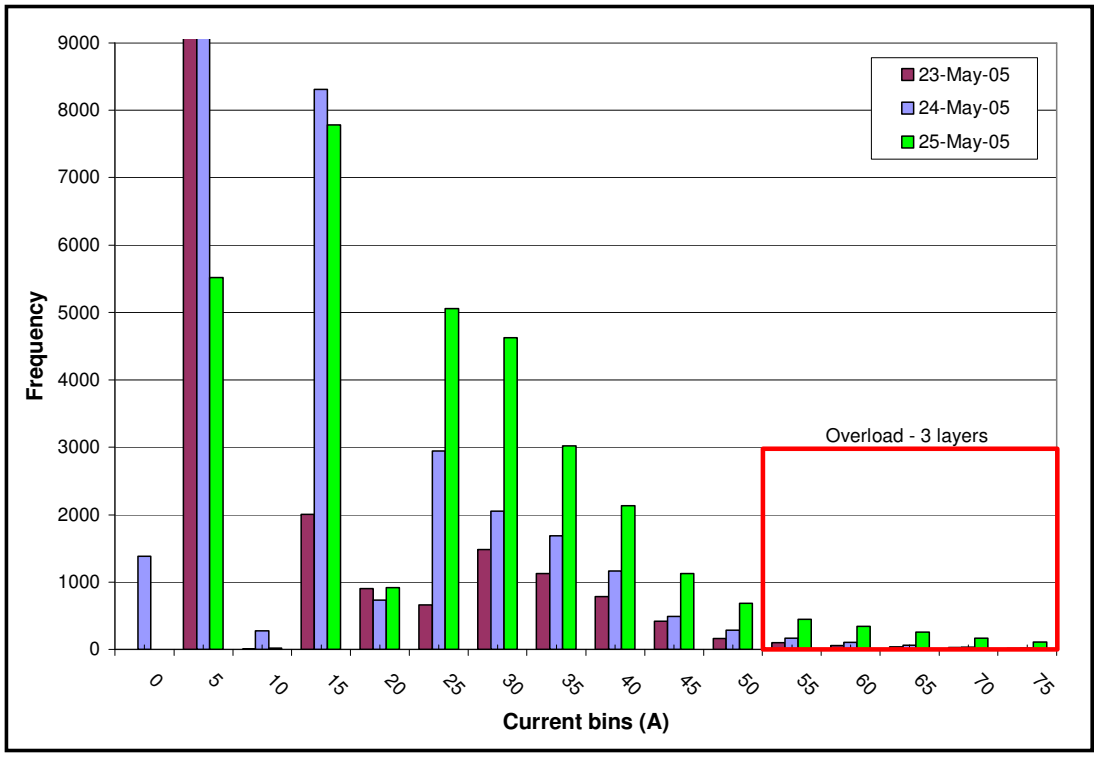

Figure F.2-3: Histogram for current consumed by a SC.

F.2.2.2 Afternoon shifts

Table F-9: Data for the total consumption of a SC in section 61.

	23-May-05	24-May-05	25-May-05
Tonnes/CM/Shift	2030	2320	1160
% Time of shift producing	-	89.35%	63.82%
% of Production time over cable rating - 1 layer	-	0.07%	0.00%
% of Production time over cable rating - 3 layers	-	5.02%	3.81%
% of Production time over cable rating - 5 layers	-	100.00%	100.00%

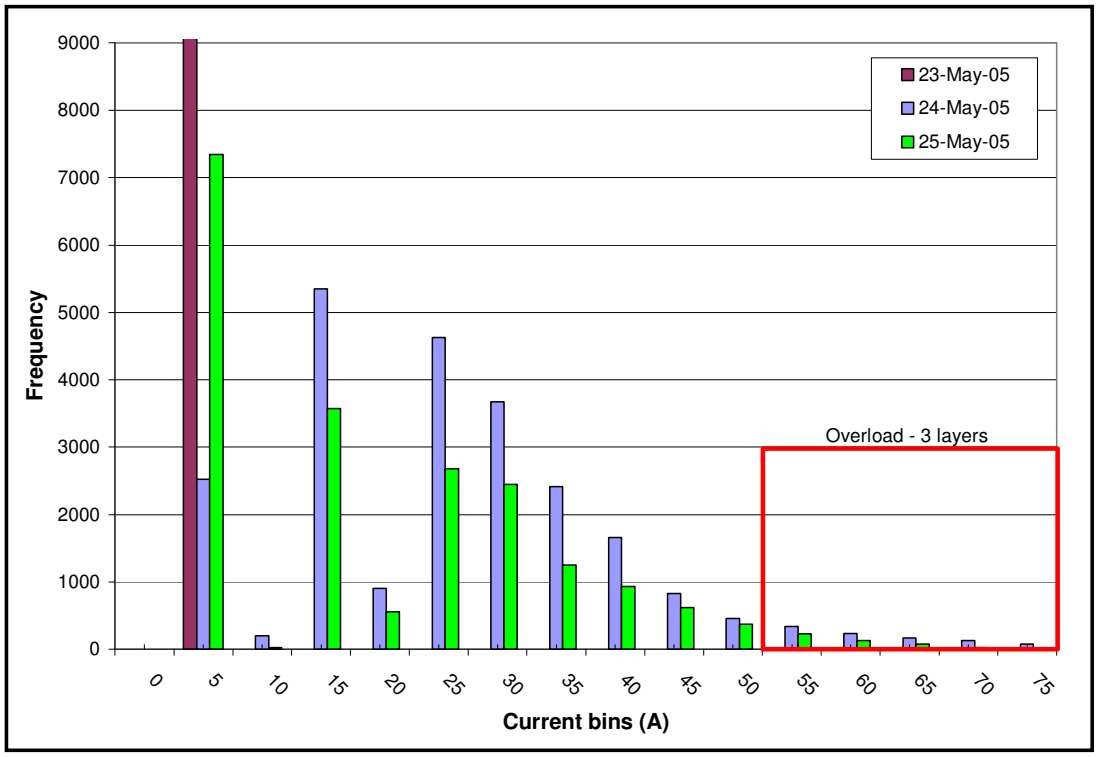

Figure F.2-4: Histogram for current consumed by a SC.